Preliminary Review :
Current Range of the Threatened Bunched Cory Cactus in Defining Potential Habitat

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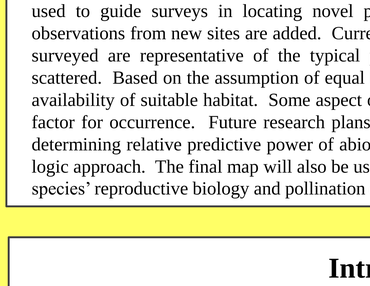
Abstract

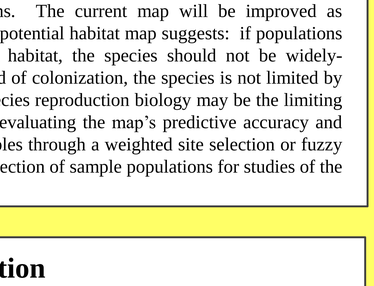
The Bunched Cory Cactus (Cactaceae; *Coryphantha ramillosa* ssp. *ramillosa*) is a threatened species limited in the U.S. to the lower canyons of the Rio Grande in Brewster and Terrell Counties. Minimal information is known about the species range below the county level. To determine the likelihood of continued survival, with respect to the degrading influence of known threats to genetic diversity and population viability, available suitable habitat must be identified. To do so, surveys were conducted at known populations during the summer of 2014 to the spring 2015 in Big Bend National Park and on private lands. The main objective was to develop a potential habitat map based on observed abiotic attributes: elevation, slope, aspect, and rock formation. The habitat map was used to guide surveys in locating novel populations. The current map will be improved as observations from new sites are added. Currently, the potential habitat map suggests: if populations surveyed are representative of the typical preferred habitat, the species should not be widely-scattered. Based on the assumption of equal likelihood of colonization, the species is not limited by availability of suitable habitat. Some aspect of the species reproduction biology may be the limiting factor for occurrence. Future research plans include evaluating the map's predictive accuracy and determining relative predictive power of abiotic variables through a weighted site selection or fuzzy logic approach. The final map will also be used for selection of sample populations for studies of the species' reproductive biology and pollination ecology.

Introduction

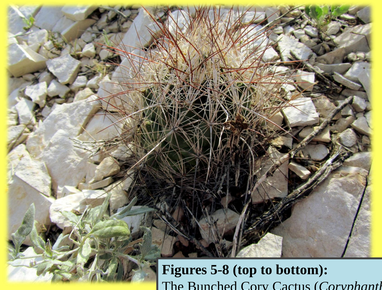
The Bunched Cory Cactus (*Coryphantha ramillosa* ssp. *ramillosa*) is a rare, little known taxon of the Southeast Texas Chihuahuan Desert Scrub (USFWS 1989, Heil and Brack 1989, Anderson and Schmalzel 1998, Schmalzel et al. 1999). The taxon is listed as imperiled globally and threatened at both the federal and state level. Small population numbers, patchy distribution, delimited habitat, as well as illegal or unregulated harvesting by collectors are considered primary threats to the taxon's long-term survival (Poole and Westlund 1991, Anderson et al. 1998, Schmalzel et al. 1999). The Bunched Cory Cactus is reported to be common within the states of Chihuahua and Coahuila, Mexico but limited to small, widely-dispersed populations in its U.S. range of Brewster and Terrell Counties, Texas (Hernandez and Barcenas 1995). The species colonizes fractures in bare limestone outcrops or in shallow residual soil deposits between limestone rocks along steep slopes of ravines and terraces (USFWS 1989, Heil and Brack 1989, Anderson and Schmalzel 1998, Schmalzel et al. 1999, Heil et al. 1985, 2013). To date, two factors, elevation and geologic formations, appear to be important in defining habitat. Plant occurrences appear to be limited to Upper Santa Elena, Lower and Upper Buda and Boquillas limestone formations at elevations between 2,500– 3,500 ft (Maxwell 1979, USFWS 1989, Heil and Brack 1989, Anderson and Schmalzel 1998, Schmalzel et al. 1999, Heil et al. 1985, 2013).

The primary objective of this investigation was to use GIS to produce a map showing potential suitable habitat for the Bunched Cory Cactus based on abiotic features, elevation, slope, aspect, and rock formation, from previously reported sites in the U.S. The map was then used to survey potential sites for populations of the rare cactus. Observations from new sites were used to improve the accuracy of the map. Future research plans include evaluating the map's predictive accuracy and determining relative predictive power of abiotic variables through a weighted site selection or fuzzy logic approach.





Figures 1-4 (top to bottom):
Habitat Big Bend National Park, private land in Brewster County (2), and Terrell County, TX.



Figures 5-8 (top to bottom):
The Bunched Cory Cactus (*Coryphantha ramillosa* ssp. *ramillosa)* on private land in Terrell County (2), Brewster County, TX and within Big Bend National Park.

Methods

Collection of Data

During the fall of 2014, a thorough literature survey, including both published and unpublished documents, was conducted to determine what has been previously reported about the taxon's life history and demography (Heil and Brack 1989, Anderson and Schmalzel 1998, Schmalzel et al. 1999, TXNDD 2015). In addition, rare plant specialists and government agency staff were contacted to lend support for the validity of observances and to learn of any novel sites recently documented. One complication in determining Bunched Cory Cactus locations is the possibility of misidentification; *Coryphantha macromeris*, a close relative, is often mistaken for the Bunched Cory Cactus. Information harvested from these sources was used to characterize the abiotic features of suitable habitats. Available data that appeared to be helpful in defining the habitat included: elevation, slope, aspect, and rock formation.

Creation of the Map

When possible, elevation, slope. aspect, and rock formations were mapped using ArcGIS for every four previously documented locations. Unfortunately, only general locations were provided by TXNDD which prevented tying the specific abiotic features to the previously documented sites. For four of these sites, permissions were obtained from land owners to survey the property for the presence of the Bunched Cory Cactus. When populations were found, GPS locations for the plants were recorded using a Trimble GIS (with sub-meter accuracy) and a binary raster of suitable and non-suitable habitat was created from the ranges of abiotic attributes extracted at every individual's location within sites observed.

Utilizing the Map

The map was used during field surveys as a guide to areas predicted to support this taxon at previously documented populations and in locating novel sites. As more sites are visited, documentation of colonized locations will hopefully lead to a more accurate reflection of the taxon's current range within the U.S.

Acknowledgements

We would like to express our gratitude towards the CITR for their Graduate Research Fellowship as well as Head-of-the-River Ranch in providing crucial funding for initiating this project. We would also like to thank Dr. Robert Dowler and Dr. Ben Skipper for their continuing patience and assistance throughout the study. Without the aid of Texas Natural Diversity Database staff private landowner surveys would not have been possible.

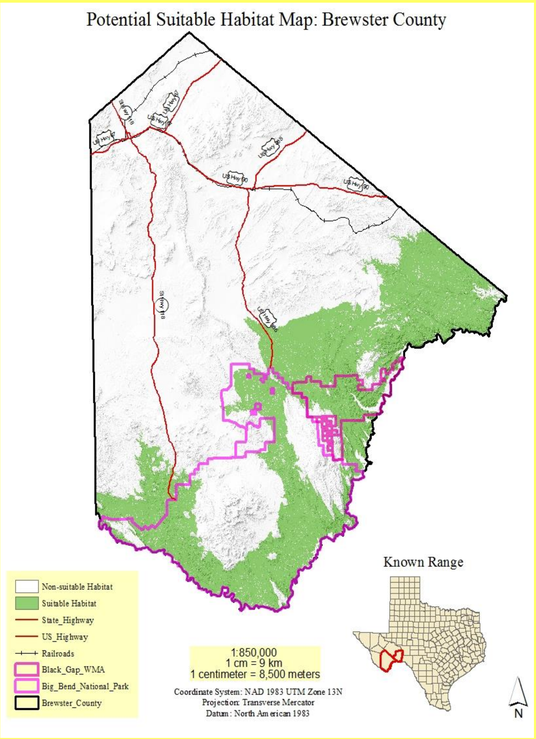
Results & Discussion

The potential habitat map created from the GPS locations of individual plants within four populations surveyed convey that habitat attributes are not as constrained as previously thought. (see Figure 10). The species occupies elevation , slope, and aspect ranges that differ from the projected with plants found within: 1893 ft. – 3031 ft. elevation; 0 °-- 39 ° slope, and 2 ° -- 358 ° aspect. In addition populations were found in Sue Peaks, Del Carmen, and Telephone Canyon Formation in addition to the previously reported Santa Elena and Boquillas Formations. The discovery of multiple new populations in this study advocates a further northeastern extension of the species range than most currently projected. It appears elevation, slope, and rock formation are more restrictive in scope and potentially better tools of measuring habitat suitability. In order to determine the degree of restriction of these attributes more populations must be surveyed. Accuracy of the final potential habitat map created will be tested using an adaptive cluster sampling design modified for populations. While we realize the total area of our survey cannot capture the full extent of the species range in U.S. counties, the inaccessibility to a majority of past site observations limits completeness at this scale. An accurate distribution map of potential habitat is vital to have species status reflect current conditions.

Figure 9:
Recording GPS coordinates for plant locations on private land in Brewster County, TX October 2014.

Figure 10:
Current predictive habitat map for Brewster Country as developed from field observations. Potentially-suitable habitat incorporates a greater amount of the Trans-Pecos landscape, extending farther northeast than projected from previous broad descriptions of its range. Precise geographic locations were not used in this illustration of the species potential distribution due to the possible threat of illegal collection.

Figure 11:
Recording GPS coordinates for plant locations on private land in Terrell County, TX March 2015.



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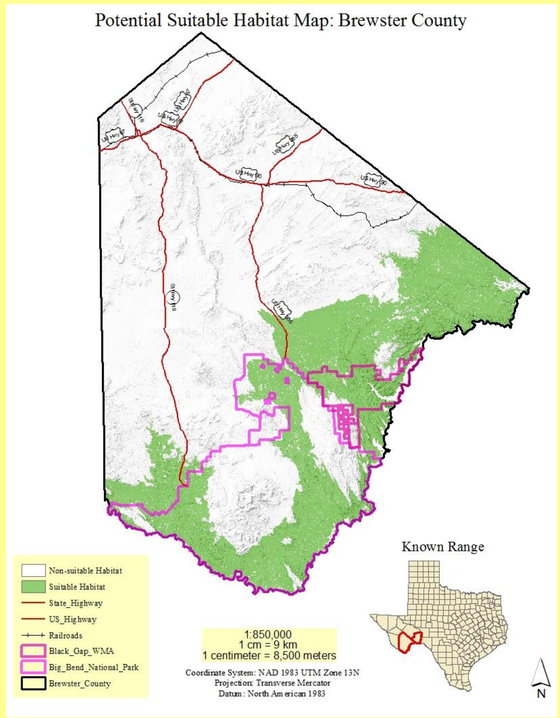

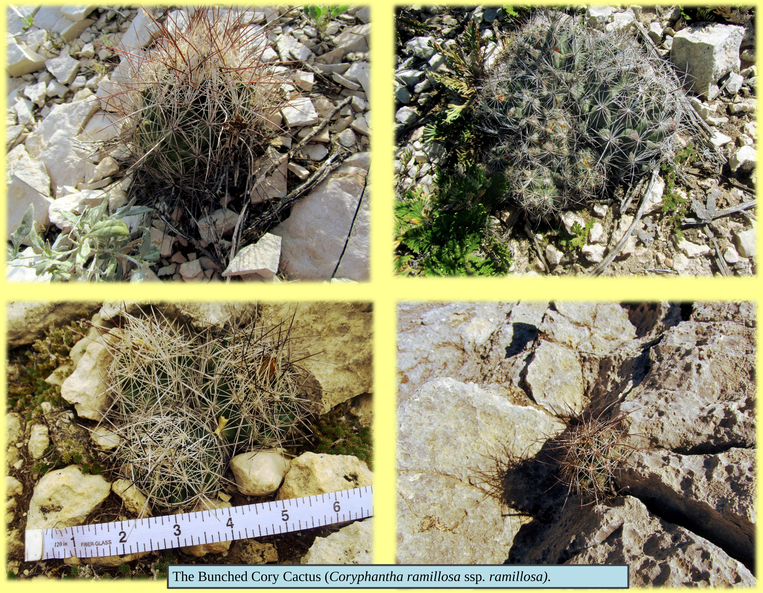

The Bunched Cory Cactus (*Coryphantha ramillosa* ssp. *ramillosa).*